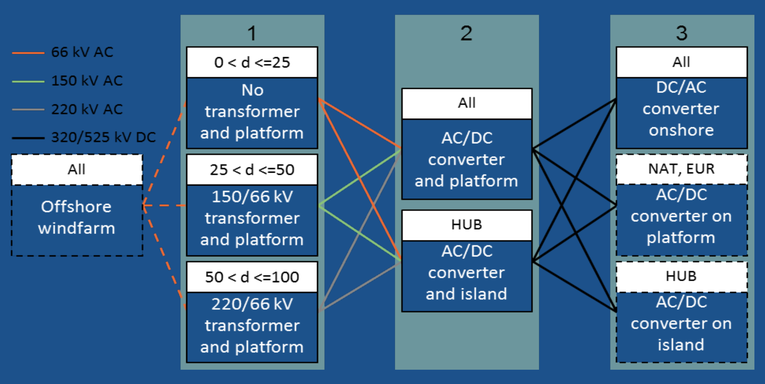
PROMOTioN
PROGRESS ON MESHED HVDC OFFSHORE TRANSMISSION NETWORKS

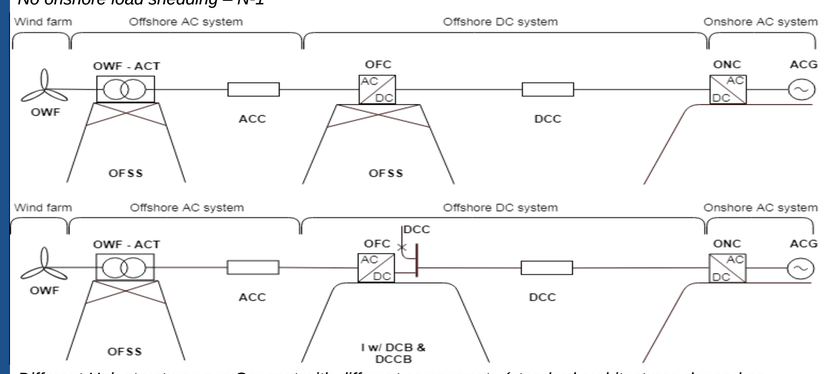
WP7-12 CBA – What does a HVDC meshed grid cost & how can it be financed?

A significant investment is required in the meshed offshore grid

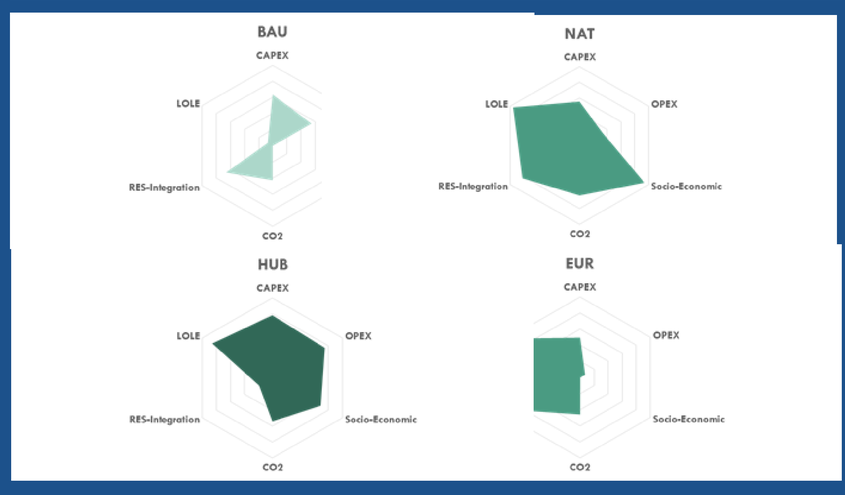
The grid is imagined to be a multitude of DC radially connected offshore windfarms, presented in the figure to the right. The exact components used depends on multiple criteria. Firstly, the distance between the OWF and offshore converter influences the choice of AC transformer and its corresponding platform. Secondly, the type of offshore support structure for the offshore converter may be a platform or, in the HUB concept only, an artificial island. Thirdly, the cable from the offshore converter may go to shore in all concepts, to the DC busbar of a converter on another platform in the NAT and EUR concepts or to the DC busbar of a converter on an island in the HUB concept. These options are summarized in the figure below.



Standard voltages, e.g. 525 KV
Standard configuration: Bipole with fixed return
Standard cable sizes – current max 2 GW
No onshore load shedding – N-1



Different Hub structures per Concept with different components (standard architectures depend on distance/power flows)
Protection Strategies determined by WP4



KPI	CONCEPT	2025	2030	2035	2040	2045	2050	TOTAL
CAPEX	BAU	27.50	28.20	22.30	43.40	34.40	30.80	**186.60**
	NAT	27.00	31.10	24.20	42.20	39.00	32.60	**196.10**
	HUB	31.90	30.00	20.30	32.30	28.70	28.70	**171.90**
	EUR	28.80	31.50	23.30	42.20	38.10	34.70	**198.50**
OPEX	BAU	1.60	4.40	6.80	10.30	14.10	17.30	**54.50**
	NAT	1.60	4.50	7.20	10.70	14.80	18.30	**57.10**
	HUB	2.00	5.30	7.70	10.50	13.40	16.30	**55.20**
	EUR	1.70	4.70	7.30	10.80	14.80	18.40	**57.80**

The table above gives the CAPEX and OPEX for the High wind scenario, per each five-year period after which their cumulative figure is shown. It can be seen from these figures that the HUB concept has the overall lowest CAPEX, amounting to 171.9 bn€ by 2050. The BAU concept follows with 186.6 bn€, after which the EUR and NAT concept have cumulatively similar costs: 198.5 bn€ and 196.1 bn€ respectively. The totals are not discounted back to 2020. Combined, the costs for the HUB concept are 7 % lower than that of the BAU concept, while the NAT and EUR concept are 4 to 8 % more expensive, due to additional equipment required.

Combining the costs with the benefits shows the HUB concept offers a positive alternative to BAU, as do NAT and EUR.

How to finance a meshed offshore grid

A long-term, stable and predictable regulatory framework is prerequisite to attract necessary capital from the market by:

- **Providing investors with long-term visibility**
- **Increasing investor confidence in remuneration level**
- **Providing clarity on investors responsibilities and liabilities**
- **Providing a good balance between incentives and risks**

Financing structures & ownership options that enable access to diverse financing sources and facilitate massive investments in a meshed offshore grid include:

- **TSOs**
  - TSO equity partnerships with private or public investors
  - TSO majority of voting rights – external investors majority of economic interest
- Tenders of transmission assets to third parties
  - high leveraged project finance structures (gearing>70%)
- **One "builder" for the meshed offshore grid - tenders to third parties**
  - dedicated equity investment fund supported by public and/or private capital and the EU

Allow the application and funding of (cross-border) anticipatory investments in order to deliver cost efficient and reliable offshore transmission infrastructure:

Short-term: EU Financial Support

- To eliminate the risk for investors
- Bridge the financing gap due to (currently) inadequate cost allocation mechanisms
- Unlock the necessary anticipatory investments where the national governments alone cannot deliver

Long-term: Regulatory Framework

- To incentivise and facilitate cross-border anticipatory investments by allowing their regulatory remuneration

Enable technological innovation in the development of offshore transmission assets through:

- **EU financial support (e.g. CEF funding, InnovFin) to:**
  - Reduce the financial risk for investors and
  - Accelerate technical progress of the industry
- **Price control incentives or competition in the design of the assets**
- **Flexible governance framework that allows use of new technologies**

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